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WELL WATER QUALITY SURVEY
OF THE
MUSSELMAN LAKE AREA

TOWN OF WHITCHURCH-STOUFFVILLE

REGIONAL MUNICIPALITY OF YORK

MAY 1987

Ministry
of the
Environment

Ontario

G. MIERZYNSKI, Director
Central Region

WELL WATER QUALITY

SURVEY OF

THE MUSSELMAN LAKE AREA

TOWNSHIP OF WHITCHURCH-STOUFFVILLE

REGIONAL MUNICIPALITY OF YORK

WELL WATER QUALITY SURVEY:	1985
REPORT:	1986

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INTRODUCTION

In 1982, a detailed water quality survey was conducted on Musselman Lake in the Town of Whitchurch-Stouffville, Regional Municipality of York. In 1984, as a result of beach closure problems on Musselman Lake, private sewage disposal surveys were conducted in the surrounding community. The findings from these surveys were combined in a report entitled, "WATER QUALITY AND PRIVATE SEWAGE DISPOSAL SURVEYS OF MUSSELMAN LAKE, WHITCHURCH-STOUFFVILLE, REGIONAL MUNICIPALITY OF YORK", dated 1985.

This report concluded that the water quality of Mussleman Lake was generally suitable for body contact recreation. The lake is a small kettle lake with a limited drainage basin area. The lake is considered enriched and likely to experience occasional algae blooms and extensive weed growth which, at times, may hinder recreational use. The present water quality status of the lake was found to be consistent with the heavy recreational and residential use that the lake receives.

No evidence was found during the 1982 survey of near-shore waters or the 1984 survey that beach closure problems were related to malfunctioning sewage systems. However, 62% of the sewage systems did not meet current standards. These sub-standard systems were brought to the attention of the Health Unit and they in turn conducted an abatement program in 1985 to investigate and correct defective sewage systems.

The private sewage disposal survey determined that a significant number of sewage disposal systems are located too close to potable water supplies. Upgrading of defective systems to meet the existing requirements of the regulations would be very difficult due to the small lot sizes and terrain constraints. As a follow-up to one of the recommendations in the report, a survey of private wells was carried out by the Ministry of the Environment in 1985, in close co-operation with the York Regional Health Unit and the Town to determine if area septic systems were contributing to impairment of the groundwater supplies in the area.

The purpose of this report is to present the results of the Health Unit's abatement program and those of this Ministry's private well water supply survey.

1985 PRIVATE SEWAGE DISPOSAL ABATEMENT PROGRAM

During 1985, the Health Unit conducted an abatement program to investigate and correct defective sewage systems identified in the 1984 survey. Their report is presented in Appendix A. The results from their abatement program support the findings presented in the 1985 Ministry report entitled "Lake Water Quality And Private Sewage Disposal Surveys Of Musselman Lake."

The Health Unit findings confirm that individual sewage systems are not causing a direct impact on lake water quality and that the bathing beach water quality is not related to malfunctioning sewage systems.

Direct pollution of the lake was substantiated in only two cases involving pipe discharges of laundry waste water and grey water into the lake.

The Health Unit is continuing its investigation of thirteen systems which are potential problems due to the separation distance to the lake required in the regulation or where there is a high water table condition on the property. Due to small lot sizes, future changes to these properties may necessitate the installation of holding tanks.

1985 MOE SURVEY OF PRIVATE WELLS

Geology and Hydrogeology

Musselman Lake is a kettle lake with a surface area of 46 hectares, a drainage basin area of 179 hectares and a maximum depth of 7.3 metres. It lies in the physiographic region known as the Oak Ridges Moraine and straddles an abrupt change in the surficial geology. To the north, are the ice-contact stratified drift deposits consisting of medium to fine grain sands. To the south of the lake, the surficial deposits are comprised of silt to sandy silt till, described as Halton Till. More than 250 private wells have been constructed around the perimeter of the lake over the years and although the description of the materials encountered by the various drillers differs slightly on the available logs on file, the overall description is consistent with the geology indicated above.

The mean lake level indicated on the recent 1:10,000 topographic coverage of the area (Sheet 1017 6350 48750) is 325.5 metres (Drawing 1). To the south, east and north of the lake, the land surface rises abruptly

within the study area peaking at or about elevation 345 metres. Along the remaining west shoreline, there is only a slight rise of perhaps 1 to 2 metres peaking at or about elevation 327 metres.

The majority of the wells constructed in this area are of the 50 mm (2") diameter variety but with the newer wells in the area there appears to be a general trend to the more conventional 101 mm (4") to 152 mm (6") diameter casing sizes utilized by most well contractors today. Few wells in the general vicinity of the lake exceed 30 metres (100') in total depth and no known domestic wells in this location penetrate beyond the 300 metre A.M.S.L.(Above Mean Sea Level) elevation. Water in the domestic wells was consistently encountered in the 330 to 315 metre elevation range.

Only one well log on file in the vicinity of the lake actually explored the soil structure beyond the 300 metre elevation. This particular test well for the Cedar Beach Park (MOE LOG 8686) located in the northeast part of the study area, was taken to a depth of 105 metres, bottoming in a clay and gravel deposit about the 230 metre (A.M.S.L.) range. Although some water was found, the yield was insufficient for the intended purposes and the supply was therefore abandoned. To date, test drilling in the Ballantrae area to the west, also failed to find any significant yields at depth. Four test wells in the latter exploration program, terminated above the bedrock contact, somewhere in the 200 metre elevation range. Bedrock in this area is gray and black shales of the Whitby Formation of Upper Ordovician Age. (Hewitt 1972).

Well Quality

To achieve the objective of Recommendation 5 of the previous report, two sample runs were conducted through the area in the summer of 1985. Due to the prevalence of the nitrates detected in the June 1985 groundwater survey, which included bacti and nitrate analyses only the test parameters were expanded for the August run. The additional parameters included the balance of the nitrogen cycle, chloride, sodium and potassium to help identify the sources of contamination.

Microbiological Analyses

These tests conducted by the Ministry of Health Laboratory in Toronto were the routine test carried out by that lab for Total Coliforms (TC) and Fecal Coliforms (FC). The TC group is comprised of all the aerobic and

facultative and anaerobic, Gram-negative non-sporeforming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C or all organisms which produce a colony with a golden-green metallic sheen within 24 hours of incubation using the MF (Membrane Filter) technique. The presence of total coliforms in water is not a specific indicator of sewage or fecal pollution but may also indicate soil run-off.

Fecal Coliforms

The FC group of bacteria is basically a sub-group of the Total coliforms and is comprised of aerobic and facultative and anaerobic Gram-negative non-sporeforming rod-shaped bacteria which ferment lactose at 44.5°C. The FC parameter is a more specific test for bacteria associated with human and animal fecal material. Fecal coliforms are found only in intestinal contents of warm blooded animals. They die fairly rapidly once outside the host environment and consequently this test has proved useful as an indicator of relatively recent fecal pollution inputs. It is however, by no means completely selective for Escherichia coli, the coliform most directly related to fecal pollution. (For an interpretation of the results see Appendix B.)

Chemical Parameters

Nitrates - are the end product of the aerobic stablization of organic nitrogen and as such they occur in contaminated waters that have undergone self-purification or aerobic treatment process. Nitrate is usually associated with septic systems or agricultural practices. The maximum acceptable concentration for nitrates outlined in the "Ontario Drinking Water Objectives" of 10 mg/L(milligrams per litre) is based on considerations of the relationship between infantile methemoglobinemia and the presence of nitrate in drinking water.

Ammonia - is the most reduced inorganic form of nitrogen in water and includes dissolved ammonia (NH^3) and the ammonium ion (NH^4+). Nitrogen fixing bacteria, living in the symbiotic association with plants or in soil or water, reduce N_2 to ammonia and the ammonium ion. Ammonia is a highly soluble compound resulting from either the decomposition of nitrogen as Nitrogenous organic matter or the microbial reduction of nitrates or nitrites under anaerobic conditions. It is a common constituent of treated sewage. Although free ammonia is often of vegetable origin and without hygenic

significance, HS concentrations in water in excess of 0.10 mg/L renders the water suspect of recent pollution (Rudolf,1930).

Nitrite - is a chemical form of nitrogen that is usually found in minute quantities in surface water. Since nitrite is unstable in the presence of oxygen, it is quickly oxidized and occurs as an intermediate form between ammonia and nitrate (nitrification) or nitrates and nitrogen gas (denitrification). The nitrite ion can be used as a nitrogen source by plants. The presence of nitrites in water indicates active biological processes influenced by organic pollution. The maximum acceptable concentration for drinking water of 1 mg/L like nitrate, was based on infant methemoglobinemia.

Total Kjeldahl Nitrogen - measures both ammonia and organic nitrogen. Both of these forms of nitrogen are present in nitrogenous organic detritus from natural biological activities. Total kjeldahl nitrogen may contribute to the overall abundance of nutrients in water and thus eutrophication. Ammonia and organic nitrogen are important for assessing available nitrogen and for biological activities. The maximum desirable concentration of 0.15 mg/L for organic Nitrogen was established primarily from aesthetic considerations. Organic Nitrogen is the difference between Total Kjeldahl and ammonia nitrogen.

Potassium - is one of the more common elements. It is one of the most active metals and reacts vigorously with oxygen and water. It is not found free in nature but only in ionized or molecular form. Potassium salts are often used for fertilizers and for this reason it was selected as one of the test elements. There are no established limits for potassium in drinking water in Ontario.

Sodium - and potassium have similar properties and it too, is an extremely active metal. Sodium salts are extremely soluble in water and tend to remain in solution. Due to its reactive properties, some sodium may be removed by the ion-exchange phenomena in the passage of ground waters through certain soils. There is no established limit for sodium in drinking water in the province, but a "cautionary" limit of 20 mg/L is advisable for parties suffering from cardiac renal or circulatory problems. "Common salt" or the compound sodium chloride, NaCl, is used as a de-icant for winter road maintenance operations, as a regenerant for water softeners and is commonly found as a constituent of septic waste. For these reasons, both the sodium and chloride ions were included in the test parameters..

Chloride - as a member of the halide group, is a major inorganic anion that occurs in variable concentrations in practically all natural waters. It may be of natural mineral origin, or as an input from any of the three sources cited in the preceding paragraph. The provincial objective of 250 mg/L was selected principally for aesthetic purposes due the salty taste which may be imparted to the water.

Survey Procedures

It was decided that the Ministry of the Environment Pollution Survey Team comprised of 6 summer staff would conduct the field work. The survey consisted of two parts, each of a week duration. The initial sampling from June 10 to 14 was intended to reflect the wet spring conditions while the second run from August 19 to 23 essentially represents the dry summer conditions. The bacti samples collected by the crew were submitted to the Ministry of Health Laboratory on Resources Road for analyses with all chemical analyses of the various water samples collected conducted by the Ministry of the Environment Laboratory also on Resources Road in Rexdale.

During the August visit, area residents were also asked to assist in completing the brief questionnaire shown in Appendix C. This questionnaire was designed to provide information to help in assessing results of the chemical and bacterial data.

Reporting of the results after each survey followed normal MOE/Health Unit protocol. Microbiological results were returned to MOE and relayed to the Health Unit. Any results exceeding <2/0 Total and Fecal Coliforms were brought to their attention and they in turn immediately notified the owner to arrange for re-sampling and to advise of remedial action.

Both agencies were copied directly by the MOE laboratory on the chemical test results. Where nitrate values exceeded the "Drinking Water Objective", owners were notified through the mail by the Health Unit.

Discussion

The properties involved in the survey were catalogued by Registered Plan (Drawing 1), and individual results are presented in Appendix "D". A total of 268 of the potential 391 private water supplies in the area were sampled. The following Table summarizes the test results:

1985 WELL SURVEY RESULTS

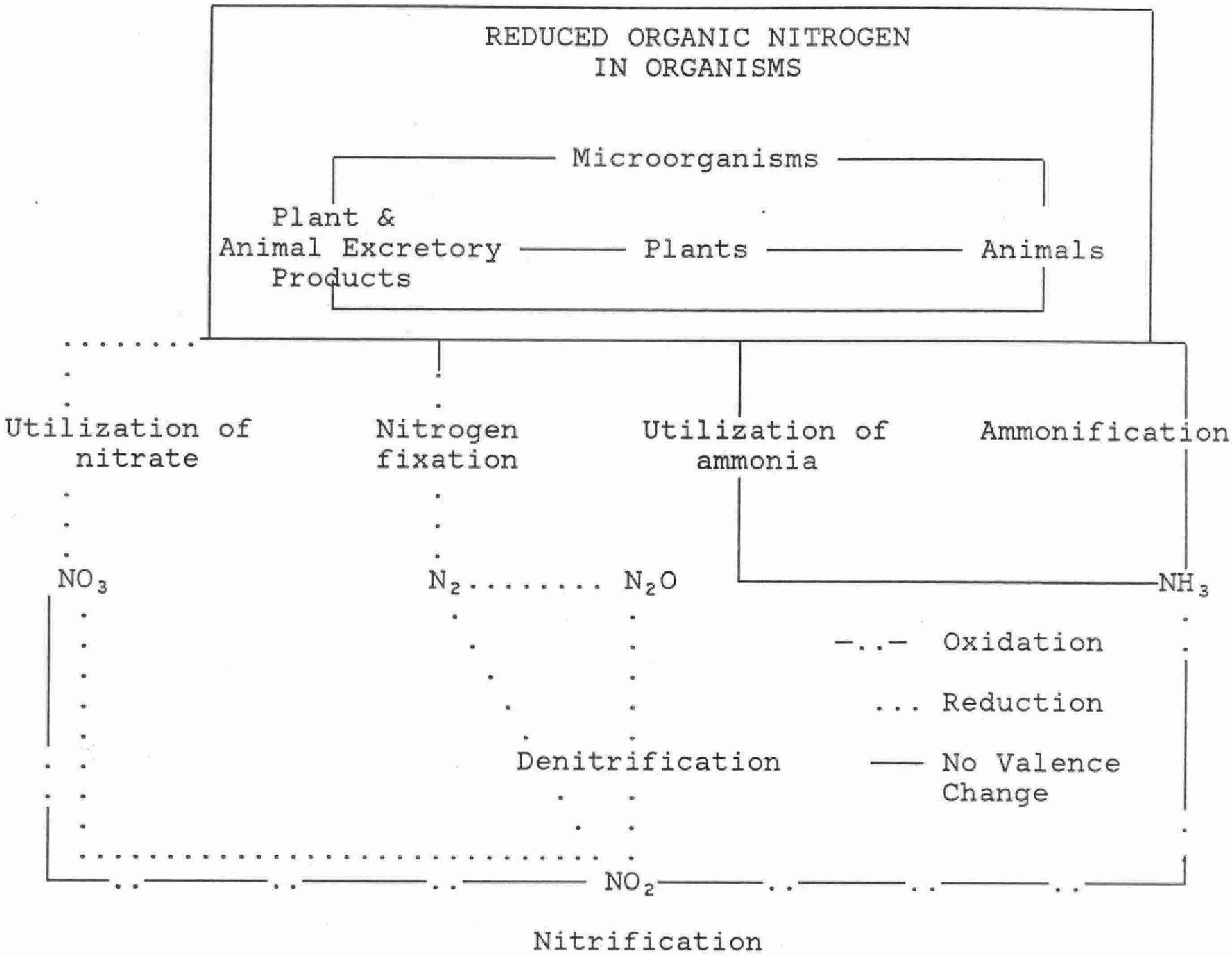
AREA	TOTAL PROPERTIES	NO. WELLS SURVEYED	NITRATES			BACTI
			1-5ppm	5-10ppm	>10ppm	F.C.≥2/0
NORTH	201	142	26-18%	48-34%	55-38%	21-14%
SOUTHWEST	93	56	5-5%	1-2%	0	14-25%
SOUTHEAST	97	70	25-36%	12-17%	8-11%	14-20%
TOTAL	391	268-69%	56-21%	61-23%	63-24%	49-18%

Bacterialogical Results

Well water supplies in the area are generally the 50mm diameter variety. These type of wells are usually a closed-system jet pump installation whereas, the larger diameter drilled wells are normally equipped with either a jet pump or a submersible pump unit. Provided the larger diameter wells are equipped with a proper tight-fitting sanitary seal or pitless adapter, they too should essentially form a closed system to the water-bearing formation. Due to the limited mobility through soil of the organisms identified by this test, bacterial contamination is generally not a problem with drilled wells if the entry of surface runoff to the well is eliminated. The low bacti counts recorded in the wells sampled in this area indicate that the majority of the supplies appear to be effectively sealed. Those few wells showing comparatively high coliform counts were likely subject to the entry of run-off directly into the well through constructional faults in the well itself or through improperly abandoned wells of similar depth in the immediate vicinity of the affected supply. The low total coliform counts recorded may have been due to minor faults in the sampling procedure rather than faults with the well supply.

Nitrogen cycle

Nitrogen usually exists in septic effluent in an organic form, primarily as ammonium. After ammonified effluent changes its environment from the anaerobic (absence of oxygen) conditions existing in a septic tank to the aerobic (presence of oxygen) condition in the upper layers of a properly functioning tile field, the ammonium is oxidized by nitrofying bacteria to nitrite and thence to nitrate according to the following sketch. In the process of denitrification, other groups of bacteria can convert nitrate to nitrite and then to the elemental and nitrogen (N^2) form.



Nitrogen Cycle. Source: Torrey. 1976

Area By Registered Plan

South - Windsor Drive -Lakeshore

To the south of the lake in Plans 135, 171, 172 and 182, the results indicate unusually high organic nitrogen values with virtually no nitrates in the majority of the wells sampled but the reverse condition, with few exception around the remainder of lake. This area lies in the Halton Till. The profile drawings based on the Water Well Records on file with this Ministry report clay from surface. The logs do however, suggest the possible existence of shallow water-bearing sand lenses at depths comparable to that of the septic systems. Prolonged discharge of septic waste to this limited zone may have rendered the waters incapable of completing the cycle to nitrate. Water Well Records indicate that supplies in this area are actually derived from a

lower aquifer in the 320-metre elevation range. The corresponding chloride levels for these supplies are considered to be above background or natural quality but fairly consistent with values generally attributed to septic waste.

All water samples (Appendix D) collected from each of the aforementioned RP's and those samples from the adjacent area zoned as Cottage Residential, all meet the maximum acceptable concentration for nitrate and nitrite listed in Table I of the "Ontario Drinking Water Objectives", but many of these same supplies, failed to meet the maximum desired concentration for organic nitrogen listed in Table 2 of that guide.

As the low plan numbers indicate, the area to the south of the lake is the oldest developed part dating back to the World War I era. Some records on file were submitted in the early years of the the Water Well Record program in the mid-fifties, yet there are likely many other supplies in existence, which actually pre-date that program for which no records are available.

With few exceptions, virtually all well supplies sampled in the remaining RP's around the lake showed at least some detectable level of nitrate. There was no consistency to the values reported however, the majority of the supplies exceeding the Provincial criteria for nitrates 10 mg/L were situated to the north of the lake.

North - Rosehill Dr. Elmvale & Balson Blvds.

Thirty-one of those well supplies with nitrates exceeding the Provincial Guidelines are located in RP's 212, 261 and 330. The stratified drift deposits in this area consisting of medium to fine sand from surface to the water-bearing formation afford little or no protection to the aquifer from the application of surface or sub-surface contaminants, ie., septic waste,road salt, water softener discharge. The nitrate results from the latter three RP's indicate a general increase in the values as you proceed to the south. This is consistent with the groundwater flow direction determined from the brief survey conducted in that area last fall.

The mean chloride levels for each of these three subdivisions are probably elevated above considered background values for the area but appear to be consistent with the general values attributed to septic waste. RP 212 had the highest mean chloride level of

the three subdivisions which again would also be consistent with the groundwater flow direction. Only one well supply, located on Balson Boulevard in RP 330, actually had a chloride value exceeding the Provincial criteria of 250 mg/L, but this particular result (Chloride 259 mg/L) was probably indicative of a water softener in use in the immediate vicinity and dramatically illustrates the potential impact the discharge of surface or subsurface contaminants can have on groundwater quality. Plans 212, 216 and 330 were registered with the Township in 1924, 1933 and 1947 respectively. A few of the water well records date back to the late 50's, however the bulk of the wells appear to have been constructed in the late 60's or early 70's.

Northwest - Connor Dr. & Highcrest Blvd.

The majority of the wells for the newest subdivision, (Plan 2045) immediately west of Plan 261, were constructed in 1982. Despite the relatively recent introduction to homes to this area, 9 of the 11 properties sampled in the subdivision still showed unusually high nitrate values suggesting a definite impact on groundwater quality from nitrates. Conversely, the corresponding chloride values were all low or indicative of considered background values. The chloride ion is relatively unreactive and moves readily through the soil matrix. For this reason it is considered as a good tracer element because of its fairly rapid movement in ground water. The test results for this particular area suggest a nitrate input other than from septic systems. Past agricultural practices on these and adjacent lands to the north may be a potential source of the input.

RP's 164 and 242 bordering on Connor Drive were established in 1918 and 1932 respectively. As with Plan 2045 to the north, nitrate levels in both subdivisions were relatively high, yet with only two exceptions, the chloride levels were comparable to the low values recorded in Plan 2045. The two high chloride values are possibly indicative of an influence from a water softener in use now or in the past in the general vicinity of these two supplies. Unlike the concentrated development around other parts of the lake, the latter two subdivisions are more or less strip development along Connor Drive. Under these conditions and in light of the low chloride values recorded in the two subdivisions, the bulk of the nitrates may be due to previous agricultural practices to the north.

North Shore - Cedarvale Blvd.

As with the latter two established subdivisions, RP 212 was developed on the north shore of the lake in the 1920's. In this case however, the area lies downgradient of two long-established developments (RP 261 and 330) to the north. In the August 1985 survey, wells in Plan 212 reflected some of the highest recorded nitrate values. In addition, chloride levels among this group were considerably higher than those recorded in wells from Plans 164 and 242 to the west and would appear to be fairly consistent with the values generally attributed to septic waste. In three of the samples, levels exceeded 100 mg/L and conceivably these supplies may also be impacted by either road-salting operations and/or water softeners in use in the general vicinity of the properties involved.

Northeast - Ninth Line

Water Well Records from RP 196 in the northeast corner of the lake indicate the distinct possibility of at least two water-bearing formations. The depth reported on the older logs are generally in the 18-metre range (Elevation 320 metres AMSL) with the newer wells penetrating to about elevation 300 metres. Water Well Records on File indicate that at least two of the five properties sampled in this group definitely derive their water from the deeper zone. Test results from these two and a third supply for which no log is available are considered to reflect background or natural quality in view of the low nitrate and chloride values whereas the remaining two supplies do show some nitrate impact. These latter two wells may terminate in a shallower zone.

East - Churchill Ave & Dr.

RP's 175 and 249 to the east of the Lake lie within the transition zone between the Halton Till to the south of the lake and the stratified drift deposits reported on the north. The wells to the east end of Churchill Drive, Plan 249, are generally about 25 metres in depth bottoming somewhere in the 320 Metre AMSL range. At least five water supplies in this vicinity reflect considered background quality in view of the low chloride and nitrate values. Towards the lake, the supplies begin to reflect some indication of nitrates and in most cases a definite increase in chloride levels above considered background values.

In RP 175, all but three of the nineteen samples collected reflect at least some variation from the considered background values for both chloride and nitrates. The mean chloride level, (Appendix D), was the highest of all areas sampled. Considering the nitrate values recorded in the wells in this vicinity, septic waste is likely one source of the chlorides but where chloride levels exceed 80 mg/L, road-salting activities and/or water softeners may also be contributing factors to the degradation of the natural water quality.

Southeast - Mitchell Ave. Victor Dr. Valley Field.

RP's 243 296 and 421 are long-established developments. A few of the 24 samples in this group reflect virtually no nitrates, yet in each case, the corresponding chloride was probably above background or natural quality. Conversely, other samples among this group reflect background chlorides yet elevated nitrates. The latter condition appears in those supplies bordering on the agricultural lands to the east of the three subdivisions. Both parameters do however, tend to show an increase as you proceed westward.

The chloride ion is used as a tracer in some groundwater studies due to it's mobility. The test results from RP's 243, 296 and 421, indicate groundwater movement to the west- southwest through these areas. The agricultural lands to the east of the three subdivisions appear to be contributing some nitrate input to the groundwater regime in view of the test results from those well supplies bordering on these lands. The general increase in both the chlorides and the nitrates within the subdivisions is probably indicative of an impact from septic systems as water migrates through the area.

RP's 239, 252 and 270 located west of the Ninth Line to the southeast of the lake and RP's 199 and 209 located due south of the lake were all beyond the limits of the sampling program.

Southwest - Appleton Ave. Byron Ave.

Only 5 water samples were collected in RP 210, none from the adjacent RP 228, yet the limited test results available, indicate reasonably good quality water in

this area. These plans were registered in 1924 and 1930 respectively. Water supplies in this vicinity are derived from a water-bearing sand in the 320 metre range underlying roughly 12 to 15 metres of clay. The impermeable nature of the clay appears to afford reasonably good protection to the formation in view of the favourable test results from this area.

West - Lakeshore Blvd.

The final area for discussion, is zoned as cottage residential. Where drilled wells appear to be the norm around the lake, a few wells in this vicinity are reported to be relatively shallow bored or dug wells. Due to the nature of their construction, this type of well is particularly prone to periodic bacterial problems from the entry of surface water. However, of the 8 supplies sampled in this vicinity, only one showed any coliform count.

As with other established areas around the lake, nitrates also appear to be a problem in this vicinity. Three of the eight samples collected showed nitrate levels exceeding the Provincial Guideline of 10 mg/L. Although a few wells in this group may be within the influence of upgradient agricultural lands, the corresponding chloride levels, appear to indicate that they are probably more consistent with nitrates from septic wastes.

Summary and Conclusions

1. The York Regional Health Unit findings confirm that there is not a community wide problem with private sewage disposal systems and a sewage project for the community of Musselman Lake is not required at this time.

2. The Health Unit's abatement program will be continued during 1986 to investigate sewage systems which are potential problems related to set-back regulations or high water table conditions.

3. Nitrates in ground water appear to be a problem around the lake with the exception of the southwest corner, in particular, RP's 210 and possibly 228.

4. Twenty-four percent of the samples collected showed nitrates greater than 10 mg/l. Forty-four percent showed levels above 1 mg/l.

5. Although there is evidence that the agricultural lands bordering on certain subdivisions are responsible for some nitrate impact on groundwater quality, septic

systems are probably responsible for the greater part of the impairment of the natural water quality. This is particularly evident from the chloride levels in the more densely populated areas around the lake.

6. Although some wells did show high bacti counts, the bulk of the supplies indicated less than 2 total coliforms or essentially zero values. Where counts were present, constructional faults with the individual well or minor errors in the sampling procedure are thought to be the cause.

Recommendations

1. The York Regional Health Unit should continue an abatement program to investigate and upgrade defective private sewage disposal systems.

2. Those parties who were notified by the Health Unit that their well supplies showed bacterial counts or that exceeded the drinking water objective for nitrate, should contact the Health Unit regarding resampling of their water.

3 Not all properties were sampled during the survey. Those parties whose wells are not listed in the appendix would be advised to contact the Health Unit regarding sampling of their water for both the bacterial and nitrate analyses. In keeping with Provincial guidelines all private well water should be checked annually for bacterial contamination and more frequently when there are known water quality problems.

4. The Municipality should undertake engineering studies to investigate alternative water supplies for the Community of Musselman Lake.

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APPENDIX A

York Region Public Health Branch 1985 Report

York Region Public Health Branch undertook an abatement program to investigate and correct defective sewage systems identified in the 1984 MOE survey. In August 1985, 153 owners were notified in writing and advised of the status of their sewage systems and the need to upgrade them.

Analysis of application records showing approved systems enabled reclassification from Class 3 or 7 to Class 1 or 2 of nine systems. The Public Health Branch policy has been to approve area beds as replacement systems. Although classified "too small" in the MOE survey, these systems are functioning satisfactorily and are similar in area to current septic tank filter beds.

Thirty- four Class 3 systems were so designated due only to lack of minimum required setbacks to potable water supply wells. In no cases were nearby wells affected by bacterial contamination. These systems are otherwise Class 2.

As a result of concerns regarding direct pollution of the lake from the following:-

1 - direct discharge to or near the lake;

2 - sewage system too close to lake (within 15 metres); and

3 - system too close to high ground water table (minimum clearance of 0.5 metres from bottom of trench).

All lakeshore properties on the north side of the lake were rechecked by the Public Health Branch. After review of the MOE survey files the banks near the lake and along the shoreline were checked for evidence of pipes and direct discharge. Any system located beneath a finished grade indicating insufficient clearance above ground water table was noted. Distances from systems to the high water line were measured. In all 18 premises along Connor Drive (Est. 81 - 99) and 20 premises along Cedarvale Blvd. (Est. 423 - 442) were inspected with findings as follows:-

Direct discharge to/near lake - 2

Est. #432 - wringer washer used approx. 3m from the lake, residue on steep bank towards the lake.

Est. #426 - direct discharge of grey water via 1 1/2" plastic pipe emerging from the bank, approx. 3m from the lake.

Est. # 82 - overflow through open top of steel tank, corrected by sealed access lid (follow up of neighbour's complaint). This sewage system is too close to the lake.

Connor Drive

Est.#	Tile Bed	GWT	Replacement
81	approx. 40'		possible
82	approx. 40'		no
85	approx. 30'		no
86	approx. 30'		no
87	approx. 20-40'		no
88	approx. 40'(grey water)		holding tank installed
89	0 - 35'	yes	no
93	approx. 30-40'	possible	no
94	<50'	possible	possibly
96	<50'	possible	possibly
97	<50' (pit privy 20')	possible	no

Cedarvale Blvd.

434	10 - 20'	yes	yes
80-438	approx. 30' (pit privy)	no	yes

The systems classified Class 4 (grey water) and Class 5 (sewage) were inspected. All of the Class 5 systems were the result of inadequate tanks (odour, rusted, needing new lid) or poorly constructed pit privies (not vermin proof or close to a well). No instances of sewage ponding from a tile bed were found.

Class 4 systems were as a result of improperly constructed leaching pits (cover, odour) or direct discharge to ground surface of grey water usually in crawl spaces under seasonal cottages. No evidence of overflow or runoff was found except in two cases. One involved a laundry machine discharging near the lake, the other a grey water pipe into the lake. Many premises have pipes bringing water from the lake for irrigation or as a water source for seasonal cottages. Direct pollution of the lake was found only in the two instances of grey water discharge noted above.

Conclusions and Recommendations

1. Individual sewage systems are not adversely affecting lake quality and are not the cause of adverse bathing beach results.

2. Indirect pollution is possible from 13 systems on the lake's north shore which are too close to the lake and/or the high ground water table. In these cases the owners cannot be forced to upgrade their systems because there is no evidence of malfunction, i.e. sewage ponding or discharge on the ground surface and the only alternative is a holding tank. Two properties (#88 and 91) have an arrangement whereby a holding tank has been installed for toilet waste and the existing system used only for grey water. This prolongs the life of the bed and eliminates the problem associated with large suspended solids, bacteria, etc. Class 1 toilets, e.g. chemical toilets, incinerating toilet, etc. may also help alleviate these problems. these solutions have been recommended to those owners whose systems are too near the lake or the ground water table. These systems are now monitored each spring to ensure that no ponding is occuring.

3. High nitrate levels in well water as demonstrated in the 1985 MOE survey are the result of high density permanent housing on the north side of the lake. (Rosehill Drive, Elmvale Blvd., Balson Blvd.).

Although originally cottage lots, conversion to permanent housing has been possible due to native sandy soil conditions which make small on-site septic tank leaching beds possible. The average lot is 5,000 sq. ft. (50' by 100' lot) with a three bedroom house and sandy soil. The MOE Manual Large Systems suggest hydrogeologic studies when design sewage flow exceed 15,000 litres per hectare. This is equivalent to a lot size of 8,000 sq. ft. for a household of four persons.

Furthermore, "the prime concern may be the possibility of ground water impairment rather than the hydraulic considerations. It is frequently on sites where soils of high hydraulic conductivity are present that the addition of sewage is most likely to affect on-site water resources."

4. Upgrading of substandard systems should be required at the time of time of application for building permits where conversion to permanent or more extensive seasonal usage would be made possible.

Footnote:

Throughout 1985 to November 1986, 15 property owners have upgraded systems from Class 3 or 4 to Class 1.

APPENDIX B

Coliform bacteria per 100 ml Total	Fecal	Interpretation
>160	>60	Unsafe for drinking. This water is contaminated and should not be used for drinking under any circumstances. Do not attempt to apply these standards and interpretations to surface waters used for swimming.
10-60	1-60	Unsafe for drinking. Pollution source may be some distance from the water source, or diluted with large volumes of pure water, or the sample may not have been received within 48 hours of being taken. Samples older than 48 hours cannot provide reliable results.
10-160	0	Unsafe for drinking. Contamination is not likely to be of sewage origin unless far removed from the water source or unless there has been a delay in receipt of sample. Common with new wells before disinfection and shallow dug wells which are not properly sealed.
1-9	0	Doubtful for a single sample, but safe for drinking if condition remains stable and supply is protected and located at least 100 ft. from any source of human or animal wastes. Repeat samples may show exactly the same results because bacteria are not distributed uniformly in water, contamination tends to enter intermittently and numbers can change during sample transit time. Frequent sampling recommended.
0	0	Safe for drinking.
Est		Unsafe for drinking. Number has been estimated due to some interference with the test. Exact number is not really critical, especially if in excess of limits shown above, for judging safety.
O/G		Doubtful condition and not recommended for drinking. No coliform bacteria could be detected because of "overgrowth" by other bacteria. This condition frequently occurs with new wells, dug wells receiving soil drainage, or wells which have been idle for sometime. Collect another sample and identify clearly "REPEAT SAMPLE:.

APPENDIX C

QUESTIONNAIRE

MUSSELMAN LAKE WELL SUPPLY

DATE: ______ EST. NO: _______ SAMPLE SUB NO. _________

WELL DATA: Dug ______ Drilled ________

Depth _____ Casing Size _____ Date Drilled _____

Owner When Drilled _____________

WEATHER CONDITIONS:

Present: __________ Previous 24 Hours: __________

LAWNS: Is Lawn Fertilized? _____________

SEWAGE DISPOSAL SYSTEMS:

Any Change Since Last Year? Yes ____ No ____

If Yes, What? ____

STO/APAB.5

APPENDIX D

PLAN SUMMARY

PLAN/AREA	PROP SAMPLED	GENERAL WELL DEPTHS	PREDMINANT MATERIAL	F AMM. & TOT Kj.	NITRATES AUG. 1985				CL (MEAN)
					<1	>1<5	5<10	>10	
Cott. Resid. south of lake	9	15-20m	10m +/- clay underlain by sand	high	9				7-49 (29)
Cott. Resid. west of lake	8	12-15m	sand	low	2	1	2	3	9-60 (30)
135	8	15-20m	10m +/- clay underlain by sand	high	6	2			6-52 (28)
142	1	12-24m	10-12m "	low	1				30
164	11	15-18m	10m +/- clay overlying sand	low		5	4	2	<1-118 (26)
171	3	24-30m	23m " "	high	3				5-18 (10)
172	9	12-15m	11m " "	high	7	2			<1-23 (10)
175	19	12-24m	clay overlying sand	low	4	8	5	2	11-152 (92)
182	5	24-30m	21m +/- "	high	5		1		16-31 (22)
196	5	16m +/- & 35m +/-	6m +/- clay overlying sand, clay again 18-33m sand	low	3			1	<1-18

REGISTERED PLAN	PROP SAMPLED	GENERAL WELL DEPTHS	PREDOMINANT MATERIAL	F AMM. & TOT Kj.	NITRATES AUG. 1985				CL (MEAN)
					<1	>1<5	5<10	>10	
210	5	18m +/-	12-15m clay underlain by sand	low	5				8-29 (14)
212	17	15-30m	sand	"		6	3	8	16-121 (55)
242	9	10m +/-	sand	"	1	2	5	1	<1-21 (6)
243	11	21-24m	12m +/- clay or clay & stones overlying sand and gravel	"	2	8		1	15-46 (25)
249	13	12-24m	sand overlying clay overlying sand	"	8	4	1		<1-49 (13)
261	20	12-21m	sand	"		7	5	8	<1-87 (23)
296	8	13-23m	15m +/- clay overlying sand	"		5	1	2	<1-75 (27)
330	31	21m +/-	sand	"	1	6	9	15	<1-259 (43)
421	5	18m +/-	13m +/- clay overlying sand	"	3	1	1		<1-79 (17)
2045	11	19m +/- & 33m +/-	sand to 21m +/- followed by clay to 33m +/- then sand	"	2	1	5	3	<1-16 (7)

				AUGUST 1985							JUNE/85	BACTI	
HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN	NITRATE (mg/l)	JUNE	AUGUST
M. Pringle	Cottage Res		49	16.5	1.10	1.40	1.60	.010<T	<.05<w	0.20			2/2
B. Palmer	" "		7	3.5	1.10	2.90	3.10	<.005<w	<.05<w	0.20			<2/0
Glendale Beach	" "		37	8.8	1.30	5.30	5.70	<.005<w	.10<T	0.40	<.10	<2/0	<2/0
D.W. Walker	" "		34	10.0	0.90	1.30	1.70	.010<T	.20<T	0.40	<.10	<2/0	<2/0
K. Pascoe	" "		35	14.0	0.75	2.40	2.70	.010<T	.75	0.30	.80	<2/0	<2/0
T. Stephen	" "		32	6.0	1.10	2.10	2.15	<.005<w	<.05<w	0.05	<.10	<2/0	<2/0
G. Simpson	" "		17	4.2	1.30	0.90	1.15	.060	<.05<w	0.25	<.10	<2/0	
M. Singh	" "		36	15.5	0.40	0.10<T	0.50<T	<.005<w	.10<T		<.10	<2/0	<2/0
P. Baughn	" "	5167	15	8.2	1.10	2.80	3.00	<.005<w	<.05<w	0.20	<.10	<2/0	2/0
M. Gray			9	2.0	0.65	<0.05<w	0.20<T	<.005<w	4.40		5.20	<2/0	<2/0
J. Smith		3738	38	11.2	0.50	"	0.30<T	<.005<w	12.80				<2/0
J. Segel			60	23.50	0.65	"	0.30<T	.010<T	12.30		7.10	8/0	2/1
B. Ellis			22	7.60	0.70	"	0.20<T	<.005<w	0.70		18.20	<2/0	<2/0
Burnie			31	12.50	0.60	"	0.30<T	<.005<w	6.30		5.30	<2/0	<2/0
L. Gray			47	13.00	0.65	"	0.30<T	<.005<w	20.50		12.90	<2/0	<2/0
D. Rate			16	6.00	1.00	"	0.20<T	<.005<w	<.05<w		<.10	<2/0	<2/0
J. Daniel		8296	13	8.40	1.60	"	0.30<T	<.005<w	6.20		7.20	<2/0	<2/0

HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN	JUNE/85 NITRATE (mg/l)	BACTI JUNE	BACTI AUGUST
				AUGUST 1985							JUNE/85	BACTI	
G. Anderson	135		28	16.5	0.50	0.1<T	0.50<T	0.04<T	2.8				4/1
R. Rowe	"		30	24.0	0.40	<.05<w	0.20<T	<.005<w	4.9				2/2
Mrs. B. Eagan	"		6	3.2	0.70	.30<T	0.70	"	<.05<w				2/1
W. Assnick	"		52	30	1.20	2.80	3.10	"	"	0.30			6e/6
P. Kainen Hall	"		23	8.0	0.75	0.30<T	0.60<T	"	"				<2/0
S. Thompson	"	8262	51	183.0	0.40	<.05<w	0.20<T	"	"		<.1	<2/0	10/6
M.A. Yakely	"		10	126.0	0.20<T	<.05<w	0.30<T	"	"		<.1	<2/0	2e/2e
J. Wylie	"		21	9.6	2.20	0.20<T	0.50<T	"	0.10<T		<.1	<2/0	9e/9
G. Dixon	142		30	12.8	0.95	0.10<T	0.40<T	<.005<w	<.05<w				<2/0
G. Nadon	164	8297	10	2.2	0.50	<.05<w	0.30<T	0.025>T	11.40		11.10	<2/0	>160/0
S. Sekulouski	"	1573	5	1.5	0.50	"	0.20<T	<.005<w	7.20		6.60	<2/0	<2/0
D. Birch	"		5	1.8	0.50	"	0.30<T	0.010<T	8.40				<2/0
E. Thorpe	"		70	2.2	0.55	"	0.20<T	<.005<w	2.90		2.00	6/0	<2/0
D. Caulford	"		3<T	1.2	0.40	"	<0.10<w	"	6.70				<2/0
M. Fullan	"		18	21.2	0.40	"	0.20<T	"	10.80				<2/0
Norton/Death	"		3.2<T	3.0	0.80	"	0.20<T	"	1.10				42/5

HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	AUGUST 1985 SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN,	JUNE/85 NITRATE (mg/l)	BACTI JUNE	AUGUST
M. Lamanna	164		118	14.0	0.60	<.05<w	0.20<T	<.005<w	4.00				<2/0
L. Bourgaize	"		10	2.20	0.50	"	0.20<T	"	9.50		11.60	110/20	>160/0
S. Pichler	"		6	3.20	0.50	"	<0.10<w	"	4.40				<2/0
N. Wilcox	"		17	4.50	0.60	"	0.20<T	"	4.70				<2/0
E. Ando	171		7	4.0	1.0	1.60	1.70	<.005<w	<.05<w	0.10			<2/0
H. Halford	171		5	3.5	1.10	2.60	2.60	"	"		<0.10	<2/0	<2/0
I. Wilson			18	3.5	0.80	1.10	1.30	"	"	0.20	<0.10	<2/0	<2/0
P. Martin	172		8	3.50	1.30	0.40<T	0.70	<.005<w	<.05<w		<0.10		1e/1
D. McMullen	"		20	8.20	1.75	0.40<T	0.6<T	<.005<w	<.05<w			<2/0	<2/0
McMullen/Gibson	"		10	3.50	0.85	<0.05<w	<0.10<w	0.07	2.20				<2/0
T. Stafford	"	9666	6	2.50	0.80	"	<0.10<w	0.28	3.30		3.20	<2/0	<2/0
E.A. White	"		23	9.50	1.15	"	0.65	<.005<w	<.05<w		0.30	<2/0	<2/0
W. Johnston	"		19	7.50	1.00	"	0.3<T	"	0.2<T		<0.10	<2/0	<2/0
J. Langrigg	"	8283	7	11.20	1.65	0.70	1.05	"	<.05<w		1.20	<2/0	4/1
F. Bollo			0.2<T	4.0	1.55	3.8	3.8	"	"				<2/0
E. Mielke			4	3.2	1.20	3.4	3.6	"	"		<0.10	<2/0	<2/0

HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	AUGUST 1985 SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN	JUNE/85 NITRATE (mg/l)	BACTI JUNE	BACTI AUGUST
J. Bond	175		72	13.0	0.95	0.05<T	0.20<T	0.01<T	29.50		34.0	<2/0	<2/0
A. Veltri	"		88	45.2	1.25	<0.05<w	"	0.08	8.60				<2/0
H.W. Foster	"	5168	152	65.0	1.40	0.05<T	"	0.01<T	3.40		3.7	<2/0	60/0
J. Fleet	"		138	46.0	1.65	0.05<T	0.30<T	"	<0.05<w				2/0
S. Dipierto	"		69	14.5	1.45	0.30<T	0.50<T	"	<0.05<w				<2/0
Gray/Sedgwiek	"	3048 8280	131	61.0	1.45	<0.05<w	0.20<T	"	6.70		7.2	<2/0	<2/0
A. Hodder	"		78	21.5	6.30	<0.05<w	0.20<T	0.015<T	10.30		12.7	<2/0	<2/0
J. Coultice	"		62	20.2	1.30	0.30<T	0.50<T	0.01<T	0.350				
J. Coultice	"		70	31.0	1.20	<0.05<w	0.20<T	0.02<T	7.50		5.4	<2/0	1/1
W. Armstrong			92	53.0	1.40	"	0.30<T	0.07	4.40				<2/0
M. Yorkiewich			104	60.0	0.95	"	0.20<T	0.10<T	9.70		10.3	<2/0	<2/0
F. Napier	"		80	44.0	1.30	"	0.30<T	0.01<T	5.40		4.9	<2/0	<2/0
J. Castle	"		69	22.2	1.40	0.40<T	0.50<T	0.01<T	<0.05<w				52/11
A. Elson	"		118	51.0	1.50	0.30<T	0.50<T	0.080	1.10		1.20	<2/0	<2/0
E. Ulbl	"		126	53.0	1.50	0.10<T	0.40<T	0.03<T	1.40				4/0
E. Blundon	"		24	15.6	0.80	<0.05<w	0.20<T	<.005<w	1.90				<2/0
R. Andress	"		140	51.0	1.60	"	"	<.005<w	4.85				<2/0
J. White	"		11	7.2	0.90	"	"	0.01<T	4.40				<2/0
I.Van Wyngarden	"	8440	120	63.0	1.30	"	"	0.015<T	2.80		2.80	<2/0	<2/0

HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	AUGUST 1985 SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN	JUNE/85 NITRATE (mg/l)	BACTI JUNE	AUGUST
R. Walker	182	2070	16	7.2	1.15	2.50	2.75	0.10<T	<.05<w	0.25	<0.10	<2/0	<2/0
R. Sutcliff	"		31	12.5	1.70	<.05<w	<0.10<w	0.01<T	0.30<T				<2/0
J. Head	"		16	11.7	1.45	1.10	1.50	0.015<T	0.20<T	0.40	<0.10	<2/0	<2/0
N. Prentouitch	"		28	14.2	1.30	0.10<T	0.30<T	<.005<w	<.05<w		<0.10	<2/0	<2/0
J. Wylie	"		20	10.0	2.05	0.20<T	0.80	<.005<w	0.10<T		<0.10	<2/0	<2/0
F. Wilkins	196		11	3.5	0.70	<.05<w	0.20<T	<.005<w	6.90				<2/0
R. Wigmore	"	5462	0.2<T	2.0	0.75	"	0.20<T	"	<.05<w		<0.10	<2/0	10/0
H.A. McQuillan	"	2109	1.2<T	2.0	0.70	"	<.10<w	"	<.05<w				2/0
G. Blackwell	"		0.2<T	2.2	0.70	"	<.10<w	"	<.05<w		<0.10	<2/0	<2/0
B. Peart	"		18	10.8	0.70	"	0.30<T	"	13.5				<2/0
H. Tillyer		10596	29	8.2	1.20	<.05<w	0.20<T	<.005<w	<.05<w				<2/0
K. Mortimer			8	3.0	1.00	0.40<T	"	"	<.05<w		<.10	<2/0	<2/0
C. Tremaine			12	4.4	1.10	<.05<w	"	"	0.10<T		0.10	<2/0	2/0
F. Wildman		10597	9	4.2	1.20	"	"	"	<.05<w		<.10	<2/0	<2/0
W. Miller		13958	12	4.0	1.30	"	"	"	0.20		0.80	<2/0	<2/0

HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	AUGUST 1985 SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN	JUNE/85 NITRATE (mg/l)	BACTI JUNE	BACTI AUGUST
G. Peet	212	3065	28	16.00	0.75	<.05<w	0.30<T	<.005<w	22.20		20.80	<2/0	<2/0
B. Cenic	"	4540	8	2.50	0.65	"	0.20<T	"	4.90				<2/0
A. Sinclair	"		121	25.50	0.80	"	0.20<T	"	9.40		7.20	<2/0	<2/0
G. Jobe	"		25	5.50	0.60	"	0.20<T	"	3.50		2.90	<2/0	<2/0
P. Gledall	"		23	26.50	0.75	"	0.40<T	"	16.10		19.20	<2/0	<2/0
L. Gorman	"		48	43.50	0.80	"	0.30<T	0.010<T	23.50		25.00	<2/0	<2/0
"	"		120	27.60	0.75	"	0.30<T	<.005<w	3.60		3.70		
G. Gallagher	"		53	6.60	0.60	"	0.20<T	"	4.30				<2/0
H. Beishuizen	"		108	26.20	0.80	"	0.20<T	"	3.70				<2/0
G. Sartori	"		106	26.50	0.80	"	0.30<T	"	3.50		3.00	<2/0	<2/0
R.H. Muir	"		40	14.50	0.75	"	0.20<T	"	10.80				<2/0
W. Paziewski	"	8289	16	7.50	0.65	"	0.30<T	"	10.70		11.30	<2/0	<2/0
V. Davies	"		73	25.50	0.80	"	0.30<T	"	8.70		8.20	<2/0	40/0
"	"	8293	52	16.60	0.85	"	0.20<T	0.010<T	6.00				10/1
K. Gilroy	"		33	40.00	1.10	"	0.30<T	<.005<w	21.00		24.00	<2/0	<2/0
R. Wilks			35	3.60	0.85	"	0.30<T	<.005<w	41.00				<2/0
F. Sampagna			40	3.20	0.85	"	0.40<T	0.010<T	28.90				160/5

HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN,	JUNE/85 NITRATE (mg/l)	BACTI JUNE	BACTI AUGUST
				AUGUST 1985									
J. Rainer	242		5	2.20	0.45	<.05<w	<0.10<w	<.005<w	3.70				<2/0
H. Benders	"		1.2<T	2.00	0.90	"	0.20<T	0.010<T	0.10<T		<0.10	<2/0	64/0
V. Carraro	"		6	2.00	0.50	"	0.30<T	<.005<w	7.90		8.30	<2/0	<2/0
W. Goodyear	"		8	2.20	0.50	"	<0.10<w	<.005<w	8.80				
R. Urbanati	"		21	2.50	0.60	"	0.20<T	0.010<T	19.50				<2/0
E. Davis	"		7	2.00	0.50	"	"	<.005<w	9.70				2/0
M. Adams	"		3.6<T	1.00	0.40	"	"	0.010<T	6.70		7.00	<2/0	<2/0
B. Brethour	"		3.0<T	1.50	0.80	"	"	0.010<T	3.60		2.60	<2/0	<2/0
L. Prospero	"		5	2.00	0.60	"	"	0.010<T	7.80		8.30		<2/0
L. Pevras	243		46	15.60	1.00	<0.05<w	0.40<T	0.020<T	21.70				
R. Loncegan	"		15	4.50	1.10	"	0.20<T	<.005<w	3.80		4.00	<2/0	<2/0
J. Rickerby	"		37	7.20	1.65	"	0.20<T	<.005<w	<.05<w				4/0
J.J. Bingham	"		24	4.80	1.40	"	0.30<T	0.050	3.30		<0.10	<2/0	<2/0
P. Fray	"		22	4.50	1.45	"	0.30<T	<.005<w	3.20		0.10		52/44
L. Grenstead	"	8446	20	3.50	0.90	"	<0.10<w	"	4.10		4.30	<2/0	<2/0
H. Dover	"	8419	23	4.20	1.25	"	"	"	2.90		2.80	<2/0	<2/0
R. Morreau	"	8445	17	3.50	1.00	"	"	"	2.50		2.20	<2/0	<2/0
R. Smith	"		19	5.20	1.25	"	"	"	1.40		1.90	<2/0	<2/0
D. Marshman	"		20	4.20	1.20	"	0.20<T	"	3.10		3.80	<2/0	<2/0
D. Foley	"	6041	33	6.00	1.35	"	<0.10<w	0.010<T	<.05<w		0.20	<2/0	<2/0

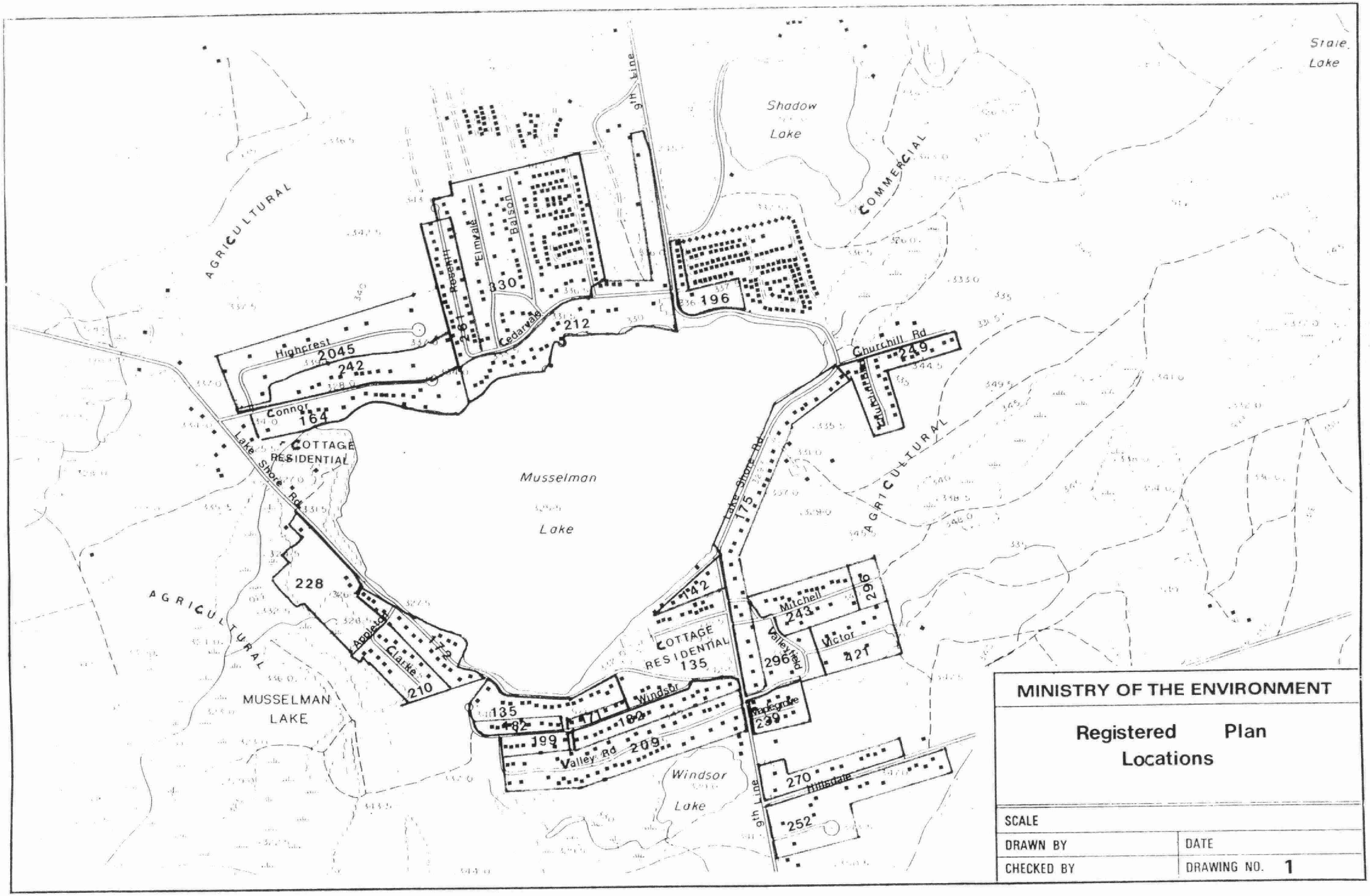
HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	AUGUST 1985 SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN	JUNE/85 NITRATE (mg/l)	BACTI JUNE	AUGUST
R. Robb	249	8441	49	14.0	1.00	<.05<w	0.20<T	<.005<w	3.80		2.90	<2/0	<2/0
M. Walker	"		48	12.5	1.25	"	"	"	3.50				<2/0
C. Insley	"		8	7.2	0.75	"	"	"	3.70		4.10	<2/0	4/0
G. Dodd	"	9159	5	2.5	1.00	"	"	"	0.20<T		<0.20	<2/0	<2/0
S. Morrison	"		34	19.0	1.00	"	<0.10<w	"	6.30				<2/0
L.C. Grove	"		7	5.6	1.20	"	0.20<T	"	<.05<w				2/0
D. Collins	"		19	10.2	0.95	"	"	"	2.50				<2/0
W.D. Crawford	"		3.4<T	8.2	1.40	"	"	"	0.40				
M. Carpenter	"	1910	3.4<T	2.5	1.40	"	"	"	<.05<w		<0.10	<2/0	<2/0
J.B. Brown	"		2.8<T	2.0	1.00	"	"	"	"		<0.10	<2/0	<2/0
A. Clelland	"	8448	1.4<T	2.0	1.05	"	"	"	"		<0.10	<2/0	<2/0
H.M. Sewell	"		1.0<T	2.0	0.90	"	0.30<T	<.010<T	"				<2/0
P. Richer	"		0.2<T	2.2	0.70	"	<0.10<T	<.005<w	"		<0.20	<2/0	<2/0

HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	AUGUST 1985 SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN	JUNE/85 NITRATE (mg/l)	BACTI JUNE	BACTI AUGUST
	261	8685	87	63.00	1.00	<.05<w	0.30<T	0.020<T	13.10				<2/0
R. Steward	"		71	39.00	1.15	"	0.20<T	<.005<w	12.40			<2/0	<2/0
G. Baxter	"	8299	32	26.50	1.10	"	0.30<T	"	13.60			<2/0	<2/0
P. Johnson	"		49	2.20	0.55	"	0.30<T	"	3.70				<2/0
D. MacDonald	"		5	2.20	0.55	"	0.20<T	"	1.10				<2/0
D. Carpenter	"		20	2.00	0.55	"	0.20<T	"	4.60		4.80	<2/0	<2/0
G. Pepik	"	2165	11	1.80	0.40	"	0.20<T	"	7.60				<2/0
W. Main	"		8	1.80	0.55	"	0.30<T	0.050	7.90				
J. Schmidt	"	1773	16	4.50	0.50	"	0.20<T	0.015<T	5.50			<2/0	<2/0
A. Brissenden	"	9945	5	1.50	0.50	"	"	<.005<w	2.50		3.10	<2/0	<2/0
J. Nasy	"		3.4<T	1.60	0.60	"	"	"	2.40		2.50	<2/0	<2/0
H. Novielli	"		2.8<T	2.40	0.50	"	"	"	1.95				<2/0
B. Couperwaite	"		5	1.20	0.50	"	"	"	5.50			<2/0	<2/0
I.B. Forbes	"		7	14.50	0.60	"	<0.10<w	"	6.50			<2/0	<2/0
S. Kunig	"		30	28.00	0.95	"	0.20<T	"	17.20			<2/0	<2/0
M. McAuley	"		25	20.50	0.75	"	<0.10<w	0.010<T	11.20				10/0
P. Bortoluzzi	"		32	12.00	0.65	0.60	0.90	1.080	4.10	0.30		<2/0	<2/0
Travers/Millar	"		18	13.00	0.85	<.05<w	0.20<T	<.005<w	10.70			<2/0	<2/0
N. Kroon	"		24	12.50	0.80	"	"	"	20.60			<2/0	<2/0
L. Rushton	"		18	15.50	0.90	"	"	"	10.50				<2/0

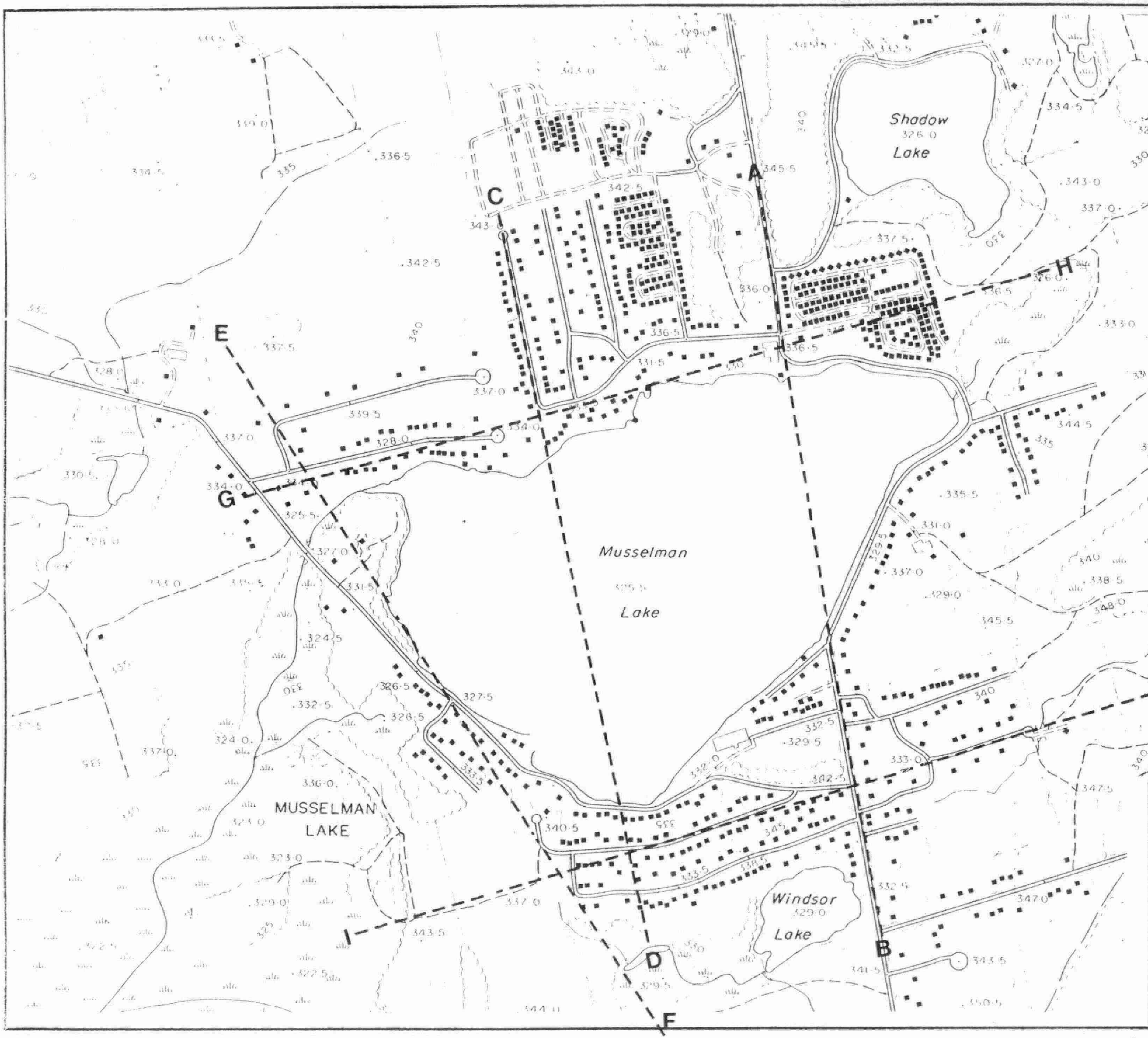
HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN	NITRATE (mg/l)	JUNE	AUGUST
				AUGUST 1985							JUNE/85	BACTI	
G.E. Gilroy	296		46	13.50	1.10	<.05<w	0.20<T	<.005<w	14.10		14.90	<2/0	<2/0
J. Maloney	"		23	8.40	0.94	"	0.20<T	"	7.30		7.60	<2/0	<2/0
B. Brown	"		75	19.00	1.00	"	<0.10<w	"	2.70			<2/0	<2/0
W. Gardener	"		2.2<T	2.20	0.80	"	0.90	<.010<T	1.20				<2/0
N. Leith	"	9661	11	11.00	0.75	"	0.20<T	<.005<w	3.90		4.00	<2/0	<2/0
N. Ragen	"	9661	7	2.50	0.75	"	"	"	3.10		3.00	<2/0	84/0
C. Joudrey	"		13	3.00	0.85	"	"	"	3.00		3.00	<2/0	<2/0
P. Craig	"		39	20.50	0.80	"	"	"	28.00		21.00	<2/0	<2/0
A. Leland	330		11	2.00	0.60	<.05<w	0.20<T	<.005<w	2.90		2.60	<2/0	<2/0
J. McCracken	"	8310	32	2.50	0.60	"	"	"	10.50				<2/0
G. Fockler	"		125	67.00	0.70	"	"	"	10.00		7.90	<2/0	<2/0
D. Bonbeer	"		61	34.00	0.95	"	"	"	14.30		17.40	<2/0	<2/0
N. Didyk	"		35	22.50	0.80	"	0.30<T	"	18.60				<2/0
D. Lumley	"		37	28.00	0.95	"	0.30<T	"	22.70				<2/0
R.H. Insley	"		76	28.00	0.90	"	0.20<T	"	12.90			<2/0	<2/0
S.W. Cooper	"		51	29.20	1.00	"	0.20<T	"	21.70		15.30	<2/0	<2/0
K. Paquin	"	4264	34	24.40	0.90	"	0.30<T	0.010<T	18.80		15.40	<2/0	<2/0
J. Greszczyszyn	"	8870	19	10.60	0.55	"	0.20<T	<.005<w	5.50		4.90	<2/0	<2/0
D. Ward	"		21	2.00	0.60	"	"	"	6.40		6.00	<2/0	4/0
F. Maynard	"		5	1.50	0.90	"	"	"	7.30		6.80	16/9	0/G

HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	AUGUST 1985 SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN	JUNE/85 NITRATE (mg/l)	BACTI JUNE	BACTI AUGUST
T. Leger	330		4	2.20	0.65	<.05<w	0.20<T	<.005<w	5.00		6.80	<2/0	
J. Caldwell	"		12	6.50	0.50	"	0.20<T	"	12.90		4.80	1/1	>160/0
S. Bell	"		26	14.00	0.70	"	0.20<T	"	15.00		13.60	<2/0	<2/0
R. Rose	"		42	19.40	0.75	"	0.30<T	0.010<T	2.90				<2/0
S. Cellerallo	"		23	53.50	0.95	"	0.30<T	<.005<w	17.70				<2/0
D. Evans	"		45	35.00	1.00	"	0.20<T	"	25.00			<2/0	<2/0
R. Holland	"		63	18.60	0.80	"	0.30<T	"	6.30				<2/0
K. Good	"		36	6.00	0.70	"	0.20<T	"	5.10			<2/0	<2/0
D.W. Williams	"	9953	0.2<T	2.00	0.65	"	<0.10<w	"	0.50				<2/0
R. King	"		13	3.50	0.50	"	0.20<T	"	4.40		3.50	<2/0	<2/0
R. Lawson	"	6124	19	10.00	0.70	"	0.20<T	"	11.60		14.10	<2/0	<2/0
C. Magnacca	"	8871	59	3.50	0.50	"	<0.10<w	"	6.50		0.80	<2/0	<2/0
R. Dawson	"		259	31.80	0.85	"	0.20<T	"	11.60		4.80	<2/0	<2/0
I. Luckasavitch	"		94	7.00	0.60	"	<0.10<w	"	3.10		2.90	<2/0	<2/0
R. Lewis	"		7	16.20	0.80	"	0.20<T	"	7.20		12.90	<2/0	<2/0
J.P. Isaac	"		53	27.20	1.00	"	0.30<T	0.020<T	11.00				<2/0
E.H. James	"	8300	61	12.50	0.70	"	0.20<T	<.005<w	7.60				<2/0
E. Cox	"		1.8<T	6.80	0.50	"	<0.10<w	"	1.60			<2/0	<2/0
W. Allen	"		10	3.20	0.55	"	<0.10<w	"	3.90				<2/0

HOME OWNER	PLAN NUMBER	WELL LOG NUMBER	CHLORIDE (mg/l)	SODIUM (mg/l)	POTASSIUM (mg/l)	FREE AMMONIA	TOTAL KJELDAHL	NITRITE (mg/l)	NITRATE (mg/l)	ORGANIC NITROGEN	JUNE/85 NITRATE (mg/l)	BACTI JUNE	BACTI AUGUST
				AUGUST 1985									
R. Leblanc	421		79	50.00	1.15	<.05<w	0.20<T	<.005<w	8.10		8.10	<2/0	
G. Lane	"		5	3.50	0.90	"	<0.10<w	"	1.30				2/0
R. Trudel	"		2.2<T	2.50	0.80	"	"	"	0.90		1.00	<2/0	<2/0
C. Noseworthy	"		1.8<T	2.50	0.85	"	"	"	0.90		1.00	<2/0	<2/0
J. Fritz	"	10388	1.2<T	2.50	0.70	"	"	"	0.50		0.50	<2/0	
J. Bender	2045	6111	6	1.80	0.55	<.05<w	0.20<T	<.005<w	9.50		10.60	<2/0	16/0
R. Morcoccia	"		5	2.00	0.50	"	"	"	10.30		11.10	<2/0	8/0
D. McArthur	"		7	2.00	0.50	"	"	"	8.70		8.70	<2/0	2/0
L. Findlay	"		0.2<T	96.00	<0.05<w	"	"	"	<.05<w		<0.10	<2/0	<2/0
J.M. Pike	"	6112	16	2.70	0.70	"	0.30<T	"	8.40		6.80	<2/0	<2/0
S. Yim	"		5	2.00	0.50	"	0.30<T	0.010<T	6.00				<2/0
M. Silvera	"	6113	7	1.50	0.55	"	0.30<T	<.005<w	7.10		7.30	<2/0	<2/0
B. Rose	"	6115	5	2.00	0.55	"	0.40<T	"	4.70		4.70	<2/0	<2/0
W. Clumpus	"		<0.2<T	3.20	1.00	"	<0.10<w	"	<.05<w		<0.10	<2/0	<2/0
W. Knecht	"		16	2.20	0.75	"	0.30<T	0.295	10.00				<2/0
A. Armer	"		6	2.50	0.60	"	0.20<T	0.250	10.50		12.20	<2/0	4/0



TRANSLAR 250-9-75

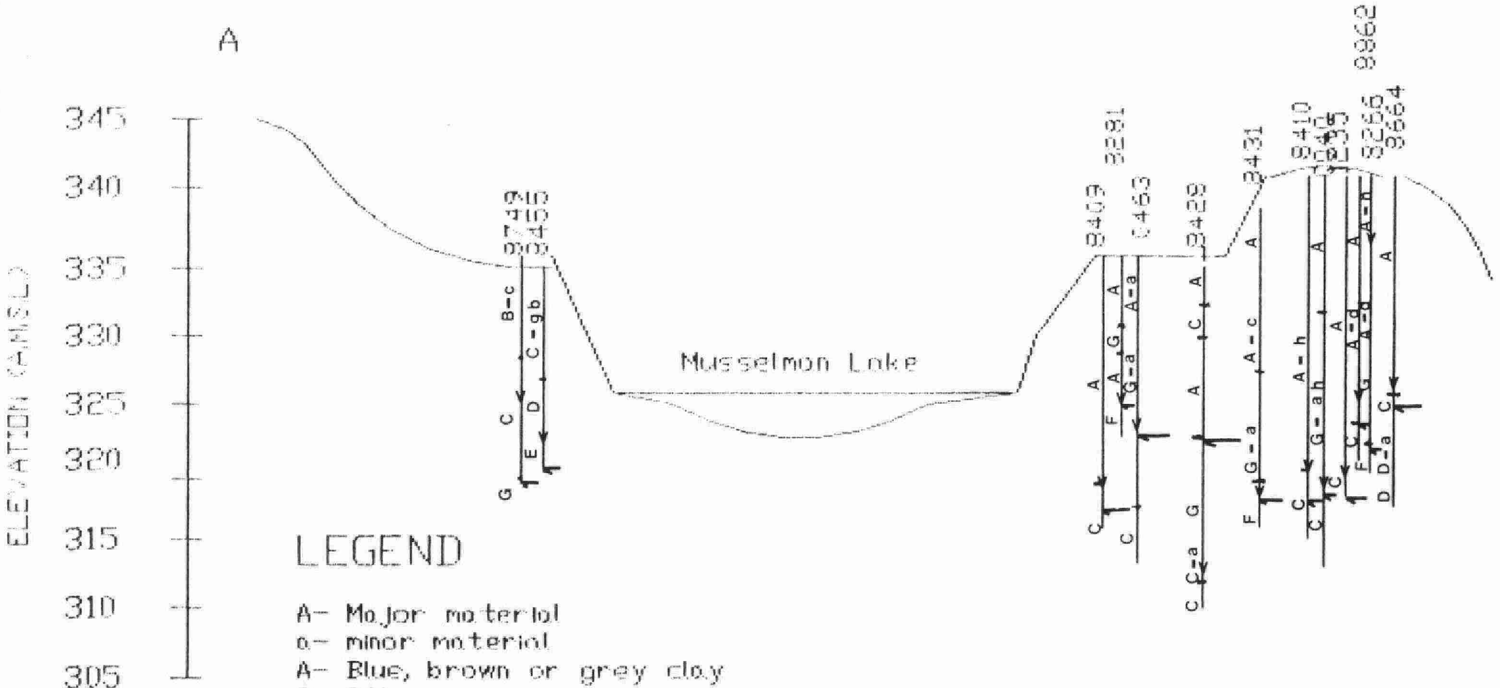


MINISTRY OF THE ENVIRONMENT

Profile Locations

SCALE	
DRAWN BY	DATE
CHECKED BY	DRAWING NO. 1a

TRANSLAR 230-9-75

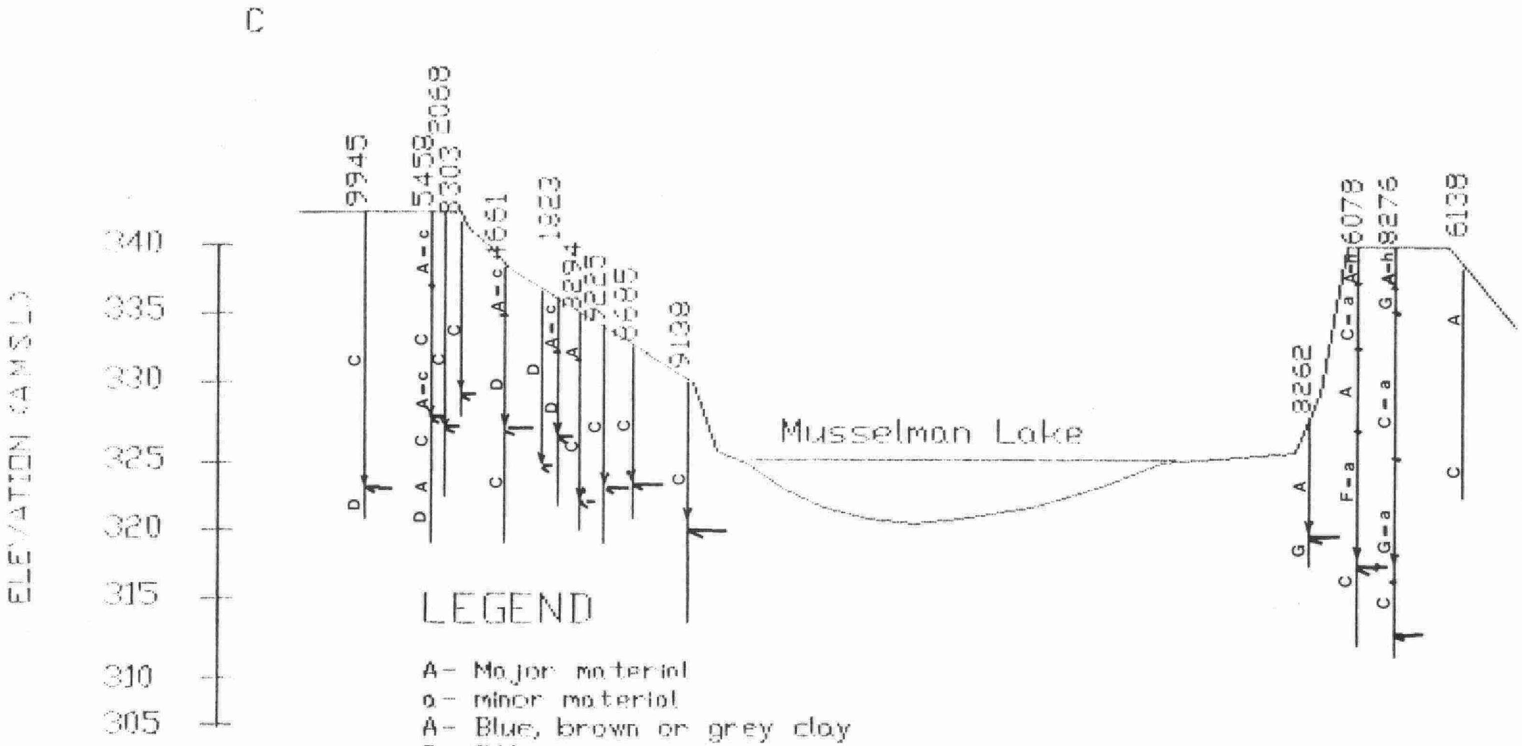


LEGEND

A- Major material
a- minor material
A- Blue, brown or grey clay
B- Silt
C- Sand
D- Fine sand
E- Medium sand
F- Coarse sand
G- Gravel
H- Stones or boulders

6789 MOE Well log
Water found at
v Original static level

MINISTRY OF THE ENVIRONMENT	
CROSS-SECTION A-B	
SCALE: Hor 1:62.5m - Vert 1:2.5m	
DRAWN BY	DATE: Apr 86
CHECKED BY	DRAWING NO 2

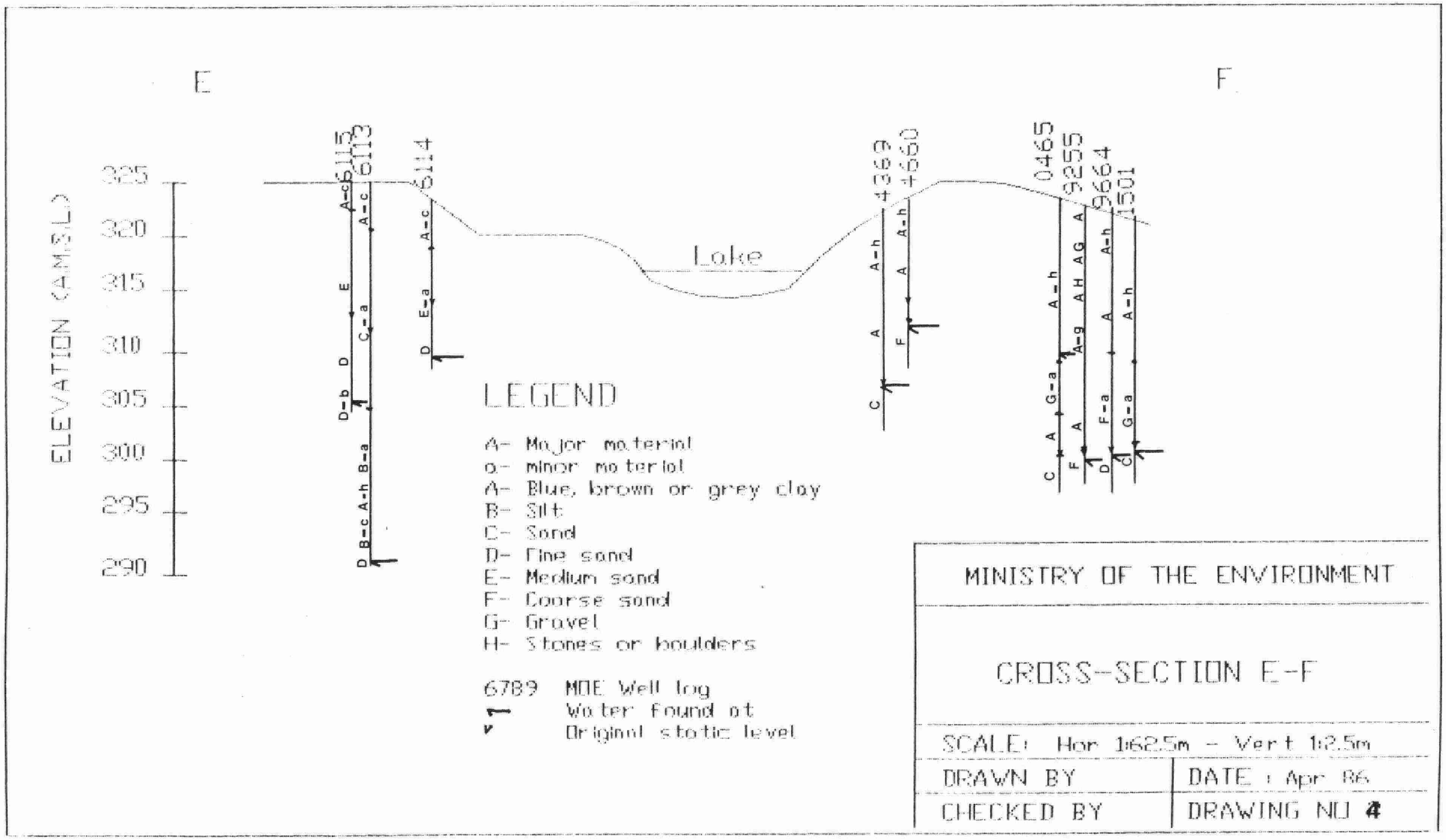


LEGEND

A- Major material
a- minor material
A- Blue, brown or grey clay
B- Silt
C- Sand
D- Fine sand
E- Medium sand
F- Coarse sand
G- Gravel
H- Stones or boulders

6789 MOE Well log
Water found at
v Original static level

MINISTRY OF THE ENVIRONMENT	
CROSS-SECTION C-D	
SCALE: Hor 1:62.5m -Vert 1:2.5m	
DRAWN BY	DATE : Apr 86
CHECKED BY	DRAWING NO **3**

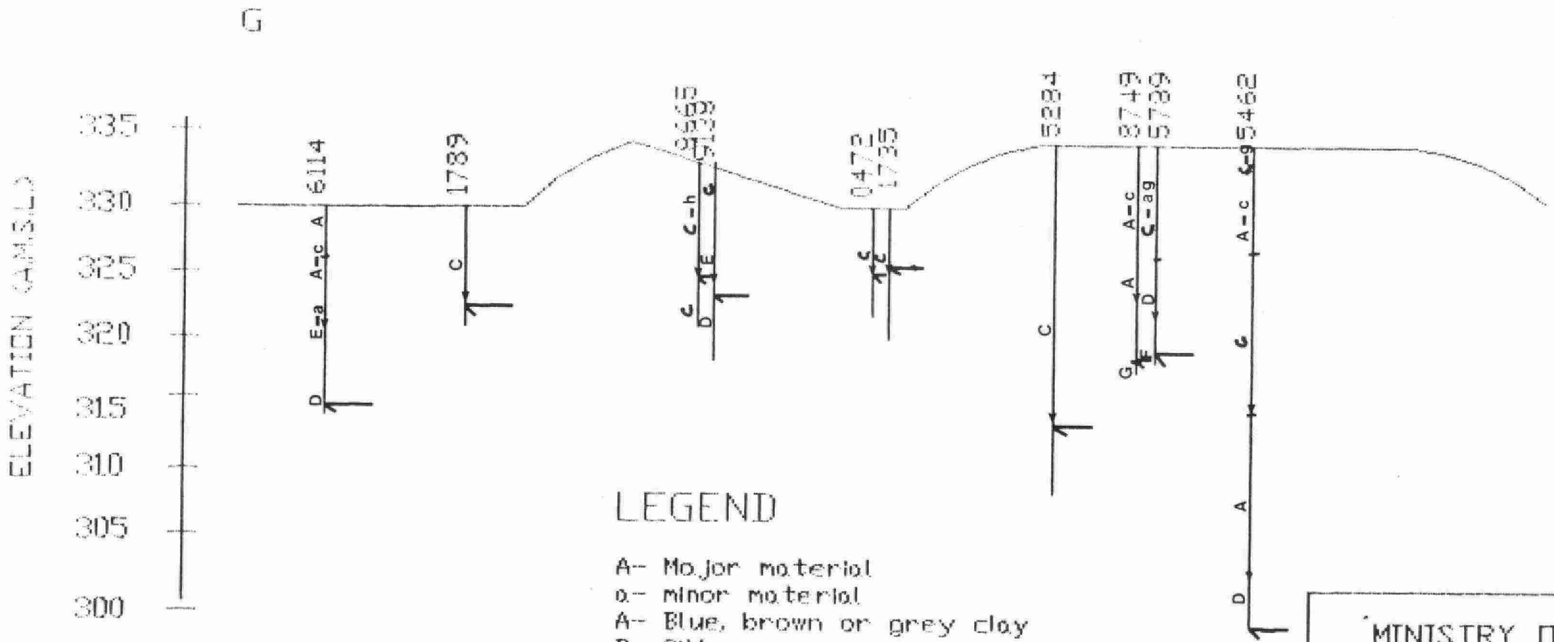


MINISTRY OF THE ENVIRONMENT

CROSS-SECTION E-F

SCALE: Hor 1:62.5m - Vert 1:2.5m

DRAWN BY	DATE : Apr 86
CHECKED BY	DRAWING NO 4



LEGEND

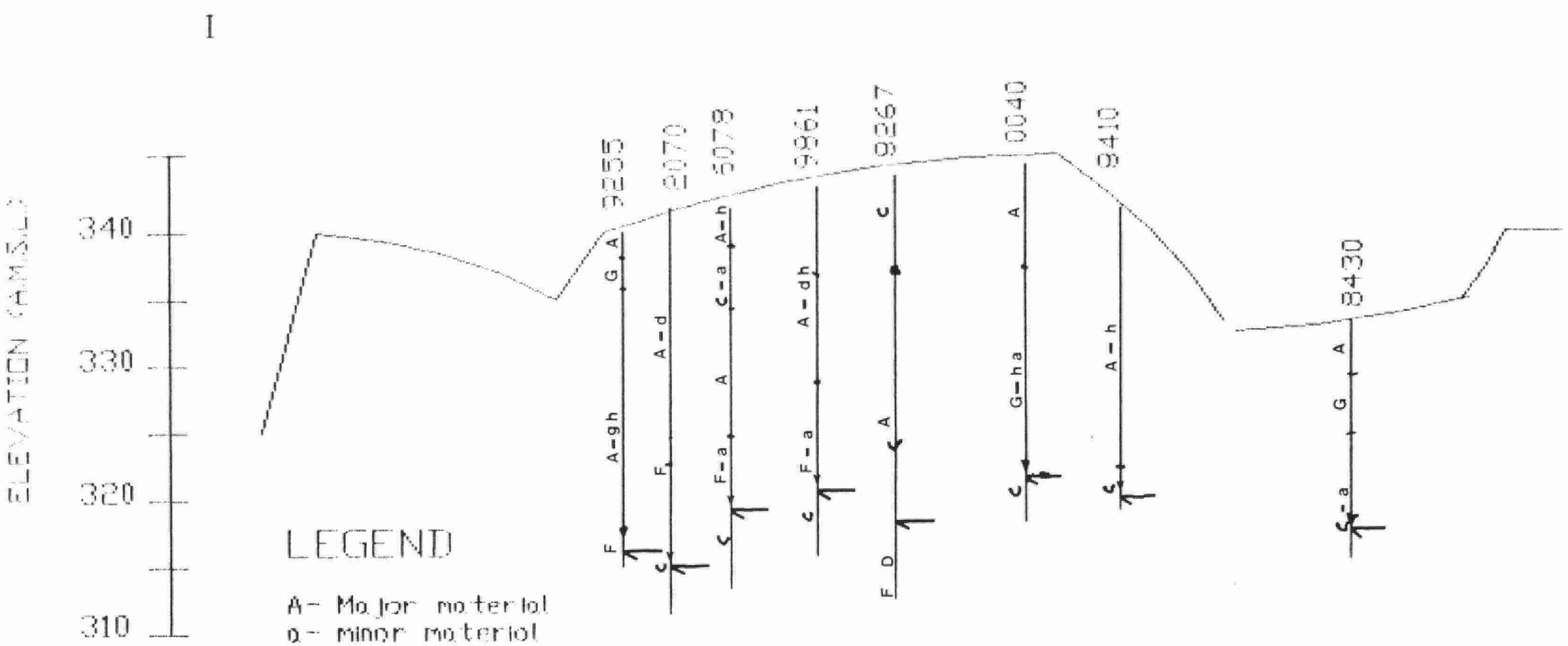
A– Major material
a– minor material
A– Blue, brown or grey clay
B– Silt
C– Sand
D– Fine sand
E– Medium sand
F– Coarse sand
G– Gravel
H– Stones or boulders

6789 MOE Well log
Water found at
Original static level

MINISTRY OF THE ENVIRONMENT

CROSS-SECTION G-H

SCALE: Hor 1:62.5m – Vert 1:2.5m	
DRAWN BY	DATE : Apr 86
CHECKED BY	DRAWING NO 8



LEGEND

A- Major material
a- minor material
A- Blue, brown or grey clay
B- Silt
C- Sand
D- Fine sand
E- Medium sand
F- Coarse sand
G- Gravel
H- Stones or boulders

6789 MOE Well log
Water found at
v Original static level

MINISTRY OF THE ENVIRONMENT

CROSS-SECTION I-J

SCALE: Hor 1:62.5m - Vert 1:2.5m	
DRAWN BY	DATE : : Apr 86
CHECKED BY	DRAWING NO **6**